Structures for computational assistance in drug design. Reply to Alexander van den Bosch

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STRUCTURES FOR COMPUTATIONAL ASSISTANCE IN DRUG DESIGN

REPLY TO ALEXANDER VAN DEN BOSCH

The title of Alexander van den Bosch's contribution is a nice allusion to the title of SiS. However, it not only deals with structures in the more specific sense of the structuralist approach as characterized in Ch. 12, it also deals with two other topics that are presented in SiS, viz. design research (Ch. 10) and computational approaches (Ch. 11). Van den Bosch explicitly deals with design research, notably drug design. Design research is normally (almost) neglected by philosophers of science, but as Van den Bosch's paper nicely illustrates, although (modern) design research is strongly related to nomological research, it makes very much sense to distinguish it from the latter, not only in goal but also in method, despite the fact that both types of research can be represented in set-theoretic terms. Moreover, Van den Bosch also indicates in his paper the way in which computational means can be used in drug design research when described in these terms, of course, with modest pretensions. Here he refers to some impressive computational studies which others from time to time attribute to me. Incorrectly, unfortunately, for they are the work of my namesake Benjamin Kuipers (no relation).

In this reply I confine myself to two related points of terminological criticism dealing with nomological research. In both cases it not only seems conceptually important in theory, but also in practice I frequently meet people who, like myself and Van den Bosch, are not always aware of some important distinctions that can and should be made.

Epistemological and Methodological Categories

In Table 1 and Figure 2 Van den Bosch categorizes the four types of conceptually possible models that are generated by the comparison of the models allowed by a theory and those that are, as a matter of *unknown* fact, empirically or nomically possible. Unfortunately, he uses the terminology that I find, apart from a specific point (see below) more appropriate for categorizing empiri-

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cally established results. Because these (and only these) categories are methodologically useful I call them the methodological categories, as distinct from the epistemological categories (ICR, p. 150 versus p. 158), corresponding to Van den Bosch's Figure 2. So, let me insert in his Table 1 my favorite epistemological terminology between brackets, where the first inserted possibility refers to my (1992, p. 303) and the second to my (ICR, p. 150):

Subset	M_T	M_E	
1	1	0	Explanatory problem (explanatory/external mistake)
2	1	1	Empirical success, confirming instance (instantial/internal match)
3	0	1	Empirical anomaly, counterexample (instantial/internal mistake)
4	0	0	Explanatory success (explanatory/external match)

Table 1. Subsets of conceptually possible models M_P of a domain (the numbered subsets in the first column refer to Figure 2 of Van den Bosch's paper)

Hence, instead of the "problem/success terminology," which I find more appropriate for methodological purposes, I prefer for (abstract) epistemological characterization the "mistake/match terminology." Regarding the two suggested *sub*categorizations, viz. "explanatory/instantial" (1992) versus "external/internal" (2000), I have no strong preferences.

The background to the main preference is the following. As soon as we become methodologically realistic, and no longer suppose that we dispose of the set of empirical or nomic possibilities (M_E), we have to base our judgements on realized (and investigated) (types of) possibilities at a certain moment (R) and the empirical regularities based on them. The latter essentially arise by inductive generalization on the basis of R. Their conjunction, which is the strongest established empirical regularity, will be indicated by S. In view of the fact that Van den Bosch explicitly speaks of "descriptive induction" at the beginning of Section 4, it may well be that he assumes in fact that S may be equated with M_E. Under certain conditions this may be reasonable, though not without the risk of being incomplete (M_E may still be a proper subset of S) or incorrect. The assumption that the data are correct in the sense that the characterizations of R and the inductive jumps leading to S are correct amounts to the claim that R is subset of M_E, and that the latter is a subset of S.

Be this as it may, as a long as we assume that R is a proper subset of S, with, if correct, M_E as an unknown set in between, we get again four categories, now methodological ones, see Figure 1.

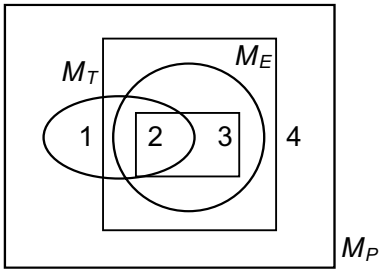

Fig. 1 (adapted from *Fig*. 2 of Van den Bosch's paper): Models M_T of a hypothesis and empirically possible models M_E of the phenomena of a domain, both part of the conceptually possible models M_P. The small rectangle indicates R, the large one S.

In our Table 2 we list first the "problem/success" names as used in (1992, p. 307) and then the first ones from ICR (p. 158), that is, the ones mentioned above, but with the qualification 'established', abbreviated by 'est'.

Subset	M_T	$R \subseteq M_E \subseteq S$		
$1 = M_T - S$	1	0	0	Explanatory problem/ est. external mistake
$2 = M_T \cap R$	1	1	1	Instantial success/ est. internal match (example)
$3 = R - M_T$	0	1	1	Instantial problem/ est. internal mistake (counterexample)
$4 = M_P - S \cup M_T$	0	0	0	Explanatory success/ est. external match

Table 2. Subsets of conceptually possible models M_P of a domain, relative to data R/S (the first column refers to the adapted version of *Fig*. 2 of Van den Bosch's paper, i.e., our *Fig.* 1)

In this way we obtain a clear distinction between epistemological and methodological categories. Of course, I do not bother about these terms as such, but about the distinction. Note that Van den Bosch talks about "empirical" successes and problems, whereas I used the qualification "instantial," but this difference is not very important.

Confirming Instances

From the foregoing it follows that one problem with Van den Bosch's terminology of 'empirical success' and 'confirming instance' is that it could better be used for the members of $M_T \cap R$ instead of those of $M_T \cap M_E$. However, my

main criticism of this terminology and, for that matter, of my 1992 terminology of 'instantial success', is that the category $M_T \cap R$ not only covers proper successes, but also realized possibilities that are merely compatible with *T*. For this reason I add to the phrase 'est. internal match' in the table on p. 158 of ICR, besides the term 'example', the phrase: *individual success* or *neutral instance*, where the former could of course also have been called 'positive instance'. This distinction is also already made in the so-called evaluation matrix (ICR, pp. 117-9; SiS, pp. 235-7, p. 307), in terms of positive and neutral instances, besides negative instances (or counterexamples), with the corresponding refinement of the notion of "being more successful."

A simple example of the crucial distinction is the fact that the hypothesis "all ravens are black" has only one type of counterexample (non-black ravens), but two types of individual successes, that is, not only black ravens, but also non-black non-ravens, and one type of neutral case: black non-ravens. The latter are merely compatible with the hypothesis, that is, the hypothesis has nothing to offer, neither when you start with something black, nor when you start with a non-raven. For a detailed analysis, see ICR, Ch. 2 and 3; see, however, also the contribution of Maher and my reply, both in the companion volume. For the moment I conclude that we should already refine our concepts and diagrams corresponding to the epistemological categories by introducing (hypothetical) proper subsets of M_T and M_E with respect to which *T*, resp. the true theory (i.e., the one characterizing M_E) has nothing to offer. This would automatically generate the suggested refinement of the methodological category of 'established internal match'. Refined diagrams for both types of categories are still missing. They will easily get complicated, in particular the methodological ones, so the challenge is to make them nevertheless as appealing as possible. For the epistemological point of departure it may be useful to start from a diagram in SiS (p. 281), drawn for a similar problem, viz. bringing 'irrelevant properties' into the picture of design research.

REFERENCE

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